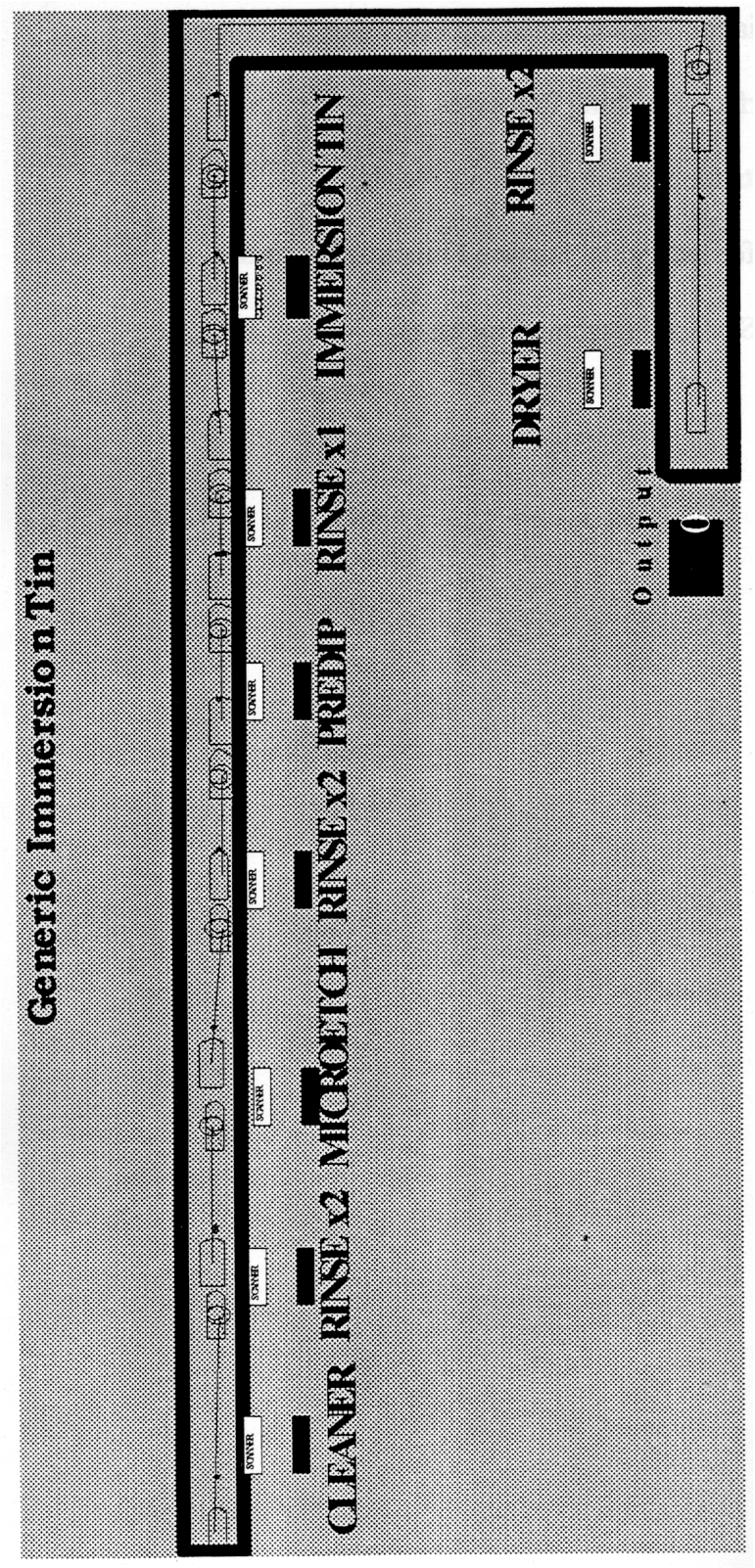
Appendix G

Supplemental Cost Analysis Information

G-1. Example Graphic Representation of Cost Simulation Model



G-2 Bath Replacement Criteria for Surface Finishing Processes

Process: HASL

Chemical Bath	Bath Replacement Criteria[a] (ssf/gal)
Cleaner	750
Microetch	570
Flux	NA[b]
Solder	NA[b]

[a] Values were selected by averaging the replacement criteria for similar bath types from other alternatives.
[b] This bath is refilled or continuously maintained through chemical additions rather than replaced. The number of bath replacements was set at one to reflect the initial bath make-up for the purposes of the computer simulation.

Process: Electroless Nickel/Immersion Gold

Chemical Bath	Bath Replacement Criteria[a] (ssf/gal)
Cleaner	750
Microetch	570
Catalyst	830
Acid Dip	1,500
Electroless Nickel	130
Immersion Gold	890

[a] Values were determined from data provided by two electroless nickel/immersion gold suppliers. To convert to units of racks per bath replacement for non-conveyorized processes, multiply by 51.1 gallons and divide by 84.4 ssf/rack.

Process: Electroless Nickel/Electroless Palladium/Immersion Gold

Chemical Bath	Bath Replacement Criteria[a] (ssf/gal)
Cleaner	750
Microetch	570
Catalyst	830
Acid Dip	1,500
Electroless Nickel	130
Preinitiator	1,200
Electroless Palladium	150
Immersion Gold	890

[a] Values were determined from data provided by two electroless nickel/immersion gold suppliers and one electroless nickel/palladium/immersion gold supplier. To convert to units of racks per bath replacement for non-conveyorized processes, multiply by 51.1 gallons and divide by 84.4 ssf/rack.

Process: OSP

Chemical Bath	Bath Replacement Criteria[a] (ssf/gal)
Cleaner	750
Microetch	570
OSP	NA[b]

[a] Values were determined from data provided by two OSP suppliers. To convert to units of racks per bath replacement for non-conveyorized processes, multiply by 51.1 gallons and divide by 84.4 ssf/rack. To convert to units of panels per bath replacement for conveyorized process, multiply by the size of the bath in gallons and divide by 5.66 ssf/panel.
[b] This bath is refilled or continuously maintained through chemical additions rather than replaced. The number of bath replacements was set at one to reflect the initial bath make-up for the purposes of the computer simulation.

Process: Immersion Silver

Chemical Bath	Bath Replacement Criteria[a] (ssf/gal)
Cleaner	750
Microetch	570
Predip	1,000
Immersion Silver	NA[b]

[a] Values were determined from data provided by two OSP suppliers. To convert to units of panels per bath replacement for conveyorized process, multiply by the size of the bath in gallons and divide by 5.66 ssf/panel.
[b] This bath is refilled or continuously maintained through chemical additions rather than replaced. The number of bath replacements was set at one to reflect the initial bath make-up for the purposes of the computer simulation.

Process: Immersion Tin

Chemical Bath	Bath Replacement Criteria[a] (ssf/gal)
Cleaner	750
Microetch	570
Predip	1,250
Immersion Tin	NA[b]

[a] Values were determined from data provided by two OSP suppliers. To convert to units of racks per bath replacement for non-conveyorized processes, multiply by 51.1 gallons and divide by 84.4 ssf/rack. To convert to units of panels per bath replacement for conveyorized process, multiply by the size of the bath in gallons and divide by 5.66 ssf/panel.
[b] This bath is refilled or continuously maintained through chemical additions rather than replaced. The number of bath replacements was set at one to reflect the initial bath make-up for the purposes of the computer simulation.

G-3 Bills of Activities for Surface Finishing Processes

Activities Associated with the Bath Setup

Activity Description	Cost Driver	Cost/Activity
Wear masks, goggles, rubber gloves, and suitable clothing	**$/bath setup**	**$2.50**
Go to storage area	labor	
Locate protective equipment	labor	
Put on protective equipment	labor	
	protective equipment	
Return to tank	labor	
Put in base liquid (usually water)	**$/bath setup**	**$2.60**
Open water valve	labor	
Wait for measured amount	labor	
Close water valve	labor	
Document water amount/level	labor	
Mix the bath solution	**$/bath setup**	**$5.00**
Open the chemical containers	labor	
Add the chemicals to the bath	labor	
Turn on the agitator	labor	
Wait for mixing	labor	
Turn off the agitator	labor	
Titrate sample	labor	
Document	labor	
Repeat as necessary	labor	
Flush containers	**$/bath setup**	**$3.00**
Turn on water valve	labor	
Spray containers	labor	
Turn off water valve	labor	
Place empty container in storage area	**$/bath setup**	**$2.00**
Take container to storage	labor	
Documentation	labor	
Return to tank	labor	
Total =	**$per testing**	**$15.10**

Activities Associated with the Tank Cleanup

Activity Description	Cost Driver	Cost/Activity
Rinse with water	**$/cleanup**	**$25.00**
Obtain spray/rinse equipment	labor	
Turn water on	labor	
Spray equipment	labor	
Turn water off	labor	
Obtain scrubbing and cleaning tools	**$/cleanup**	**$1.00**
Go to storage area	labor	
Find necessary tools	labor	
Return to tank	labor	
Hand scrub tank	**$/cleanup**	**$30.00**
Put on gloves, choose tool	labor	
Scrub tank	labor	
	cleaning supplies	
Return cleaning tools	**$/cleanup**	**$1.25**
Go to the storage area	labor	
Place tools in correct place	labor	
Return to tank	labor	
Spray according to schedule	**$/cleanup**	**$5.00**
Wait for time to elapse before spraying	labor	
Obtain spray equipment	labor	
Turn spray on	labor	
Spray all cleaning solution from tank	labor	
Turn spray off	labor	
Operator opens control valve	**$/cleanup**	**$1.00**
Find correct control valve	labor	
Open valve	labor	
Water goes to treatment facility	**$/cleanup**	**$2.75**
Wait for water to drain	labor	
Operator closes control valve	**$/cleanup**	**$1.00**
Locate correct control valve	labor	
Close valve	labor	
Total =	**$per testing**	**$67.00**

Activities Associated with Sampling and Testing

Activity Description	Cost Driver	Cost/Activity
Get sample	**$/testing**	**$1.35**
Go to the line	labor	
Titrate small sample into flask	labor	
	materials	
Transfer to lab	labor	
Test sample	**$/testing**	**$1.35**
Request testing chemicals	labor	
Document request	labor	
Locate chemicals	labor	
Add chemicals to sample	labor	
	materials	
Mix	labor	
Document the results	labor	
Return testing chemicals	labor	
Relay information to line operator	**$/testing**	**$1.00**
Return to line	labor	
Inform operator of results	labor	
Document	labor	
Total =	**$per testing**	**$3.70**

Activities Associated with Filter Replacement

Activity Description	Cost Driver	Cost/Activity
Check old filter	**$/replacement**	**$1.50**
Pull canister from process	labor	
Inspect filter	labor	
Decide if replacement is necessary	labor	
Get new filer	**$/replacement**	**$1.75**
Go to storage area	labor	
Locate new filters	labor	
Fill out paper work	labor	
Return to tank	labor	
Change filter	**$/replacement**	**$12.25**
Pull old filter from canister	labor	
Replace with new filter	labor	
	filter	
Replace canister	labor	
Fill out paper work	labor	
Dispose of old filter	**$/replacement**	**$2.00**
Take old filter to disposal bin/area	labor	
Dispose of filter	labor	
Return to tank	labor	
Fill out paper work	labor	
Total =	**$per replacement**	**$17.50**

Activities Associated with Transportation

Activity Description	Cost Driver	Cost/Activity
Paperwork and maintenance	**$/transportation**	**$1.10**
Request for chemicals	labor	
Updating inventory logs	labor	
Safety and environmental record keeping	labor	
Move forklift to chemical storage area	**$/transportation**	**$3.22**
Move to forklift parking area	labor	
Prepare forklift to move chemicals	labor	
Move to line container storage area	labor	
Prepare forklift to move line container	labor	
Move forklift to chemical storage area	labor	
Locate chemicals in storage area	**$/transportation**	**$1.15**
Move forklift to appropriate areas	labor	
Move chemical containers from storage to staging	labor	
Move containers from staging to storage	filter	
Preparation of chemicals for transfer	**$/transportation**	**$1.78**
Open chemical container(s)	labor	
Utilize correct tools to obtain chemicals	labor	
Place obtained chemicals in line container(s)	labor	
Close chemical container(s)	labor	
Place line container(s) on forklift	labor	
Transport chemicals to line	**$/transportation**	**$1.15**
Move forklift to line	labor	
Unload line container(s) at line	labor	
Move forklift to parking area	labor	
Transport chemicals from line to bath	**$/transportation**	**$.88**
Move line container(s) to bath	labor	
Clean line container(s)	labor	
Store line container(s) in appropriate area	labor	
Total =	**$per testing**	**$9.28**

G-4 Simulation Model Outputs for Surface Finishing Processes

NAME: HASL, non-conveyorized
Throughput: 260,000K ssf

ARENA Simulation Results

Replication ended at time: 17831.4 min.

Tally Variables

Identifier	Average	Half Width	Minimum	Maximum	Observations
Takt Time	5.7866	(Corr)	1.4700	141.10	3080
Time in system	19.957	4.8613	7.9560	168.71	3081

Counters

Identifier	Count	Limit
Parts Done	3081	Infinite

Frequencies

Identifier	Category	Number	AvgTime	Percent	Percent
STATE (Microetch3_R)	BUSY	3075	1.4728	25.40	25.40
	IDLE	3075	3.9279	67.74	67.74
	FAILED	9	136.00	6.86	6.86
STATE (Cleaner3_R)	BUSY	2251	4.7494	59.96	59.96
	IDLE	2250	2.7503	34.70	34.70
	FAILED	7	136.00	5.34	5.34
STATE (flux3_R)	BUSY	3081	.18000	3.11	3.11
	IDLE	3082	5.5615	96.13	96.13
	FAILED	1	136.00	0.76	0.76
STATE (solder3_R)	BUSY	3081	.12600	2.18	2.18
	IDLE	3082	5.6155	97.06	97.06
	FAILED	1	136.00	0.76	0.76

NAME: HASL, non-conveyorized
Throughput: 60,000K ssf

ARENA Simulation Results

Replication ended at time: 2876.64 min.

Tally Variables

Identifier	Average	Half Width	Minimum	Maximum	Observations
Takt Time	3.8531	.69813	3.4700	139.47	710
Time in system	89.058	(Corr)	7.9560	279.95	711

Counters

Identifier	Count	Limit
Parts Done	711	Infinite

Frequencies

Identifier	Category	Number	AvgTime	Percent	Percent
STATE (Microetch3_R)	BUSY	577	1.8113	36.33	36.33
	IDLE	575	2.4756	49.48	49.48
	FAILED	3	136.00	14.18	14.18
STATE (Cleaner3_R)	BUSY	3	822.39	85.77	85.77
	IDLE	1	137.47	4.78	4.78
	FAILED	2	136.00	9.46	9.46
STATE (flux3_R)	BUSY	711	.18000	4.45	4.45
	IDLE	712	3.6694	90.82	90.82
	FAILED	1	136.00	4.73	4.73
STATE (solder3_R)	BUSY	711	.12600	3.11	3.11
	IDLE	712	3.7233	92.16	92.16
	FAILED	1	136.00	4.73	4.73

NAME: HASL, conveyorized
Throughput: 60,000K ssf

ARENA Simulation Results

Replication ended at time: 2348.82 min.

Tally Variables

Identifier	Average	Half Width	Minimum	Maximum	Observations
Takt time	.19281	.02704	.16654	136.00	10600
Time in system	19.009	(Corr)	4.9888	140.82	10601

Counters

Identifier	Count	Limit
Depart 33_C	10601	Infinite

Frequencies

Identifier	Category	Number	AvgTime	Percent	Percent
STATE (Cleaner_R)	BUSY	9825	.00539	2.59	2.59
	IDLE	9823	.17549	84.14	84.14
	FAILED	2	136.00	13.28	13.28
STATE (solder_R)	BUSY	10601	.00500	2.59	2.59
	IDLE	10601	.17544	90.77	90.77
	FAILED	1	136.00	6.64	6.64
STATE (flux_R)	BUSY	10601	.00500	2.59	2.59
	IDLE	10601	.17544	90.77	90.77
	FAILED	1	136.00	6.64	6.64
STATE (Microetch_R)	BUSY	10601	.00500	2.59	2.59
	IDLE	10601	.17544	90.77	90.77
	FAILED	1	136.00	6.64	6.64

NAME: HASL, conveyorized
Throughput: 260,000K ssf

ARENA Simulation Results

Replication ended at time: 8908.24 min.

Tally Variables

Identifier	Average	Half Width	Minimum	Maximum	Observations
Time in system	21.188	10.277	4.9888	140.91	45936
Takt time	.18000	(Corr)	.16654	136.00	45935

Counters

Identifier	Count	Limit
Depart 33_C	45936	Infinite

Frequencies

Identifier	Category	Number	AvgTime	Percent	Percent
STATE (Cleaner_R)	BUSY	42056	.00546	2.73	2.73
	IDLE	42051	.17506	87.56	87.56
	FAILED	6	136.00	9.71	9.71
STATE (solder_R)	BUSY	45936	.00500	2.73	2.73
	IDLE	45936	.17506	95.65	95.65
	FAILED	1	136.00	1.62	1.62
STATE (Microetch_R)	BUSY	45936	.00500	2.73	2.73
	IDLE	45932	.16027	87.56	87.56
	FAILED	6	136.00	9.71	9.71
STATE (flux_R)	BUSY	45936	.00500	2.73	2.73
	IDLE	45937	.17506	95.65	95.65
	FAILED	1	136.00	1.62	1.62

NAME: Nickel/Palladium/Gold, non-conveyorized
Throughput: 260,000K ssf

ARENA Simulation Results

Replication ended at time: 114576.0 min.

Tally Variables

Identifier	Average	Half Width	Minimum	Maximum	Observations
Time in system	116.79	1.0484	106.86	278.21	308
Takt Time	38.848	(Corr)	17.830	131.33	3080

Counters

Identifier	Count	Limit
Parts Done	3081	Infinite

Frequencies

Identifier	Category	Number	AvgTime	Percent	Percent
STATE (Acid Dip_R)	BUSY	3073	1.6342	4.19	4.19
	IDLE	3070	37.226	95.43	95.43
	FAILED	4	113.00	0.38	0.38
STATE (Catalyst_R)	BUSY	3075	3.7372	9.60	9.60
	IDLE	3070	35.045	89.84	89.84
	FAILED	6	113.00	0.57	0.57
STATE (Cleaner_R)	BUSY	3069	3.4835	8.93	8.93
	IDLE	3062	35.362	90.41	90.41
	FAILED	7	113.00	0.66	0.66
STATE (Electroless Palla	BUSY	3008	4.7321	11.89	11.89
	IDLE	2975	34.179	84.91	84.91
	FAILED	34	113.00	3.21	3.21
STATE (Immersion Gold_R	BUSY	2803	19.598	45.87	45.87
	IDLE	2798	22.926	53.56	53.56
	FAILED	6	113.00	0.57	0.57
STATE (Preinitiator_R)	BUSY	3081	2.3000	5.92	5.92
	IDLE	3082	36.375	93.61	93.61
	FAILED	5	113.00	0.47	0.47
STATE (Electroless Nicke	BUSY	2872	19.663	47.16	47.16
	IDLE	2833	20.743	49.07	49.07
	FAILED	40	113.00	3.77	3.77
STATE (Microetch_R)	BUSY	3064	1.4781	3.78	3.78
	IDLE	3056	37.373	95.37	95.37
	FAILED	9	113.00	0.85	0.85

NAME: Nickel/Palladium/Gold, non-conveyorized
Throughput: 60,000K ssf

ARENA Simulation Results

Replication ended at time: 25807.8 min.

Tally Variables

Identifier	Average	Half Width	Minimum	Maximum	Observations
Time in system	115.87	1.7495	106.86	199.39	711
Takt Time	38.929	(Corr)	17.830	131.33	710

Counters

Identifier	Count	Limit
Parts Done	711	Infinite

Frequencies

Identifier	Category	Number	AvgTime	Percent	Percent
STATE (Acid Dip_R)	BUSY	711	1.6300	4.17	4.17
	IDLE	712	37.269	95.43	95.43
	FAILED	1	113.00	0.41	0.41
STATE (Cleaner_R)	BUSY	709	3.4797	8.87	8.87
	IDLE	707	35.522	90.32	90.32
	FAILED	2	113.00	0.81	0.81
STATE (Catalyst_R)	BUSY	707	3.7511	9.54	9.54
	IDLE	706	35.311	89.65	89.65
	FAILED	2	113.00	0.81	0.81
STATE (Electroless Palla	BUSY	695	4.7263	11.81	11.81
	IDLE	688	34.329	84.94	84.94
	FAILED	8	113.00	3.25	3.25
STATE (Immersion Gold_R	BUSY	652	19.443	45.59	45.59
	IDLE	651	22.895	53.60	53.60
	FAILED	2	113.00	0.81	0.81
STATE (Preinitiator_R)	BUSY	711	2.3000	5.88	5.88
	IDLE	711	36.651	93.71	93.71
	FAILED	1	113.00	0.41	0.41
STATE (Electroless Nicke	BUSY	670	19.451	46.87	46.87
	IDLE	663	20.751	49.48	49.48
	FAILED	9	113.00	3.66	3.66
STATE (Microetch_R)	BUSY	707	1.4783	3.76	3.76
	IDLE	706	37.427	95.02	95.02
	FAILED	3	113.00	1.22	1.22

NAME: Nickel/Gold, non-conveyorized
Throughput: 260,000K ssf

ARENA Simulation Results

Replication ended at time: 86437.5 min.

Tally Variables

Identifier	Average	Half Width	Minimum	Maximum	Observations
Takt Time	27.062	1.2220E-14	17.830	134.33	3080
Time in system	98.948	2.0602	86.100	286.16	3081

Counters

Identifier	Count	Limit
Parts Done	3081	Infinite

Frequencies

Identifier	Category	Number	AvgTime	Percent	Percent
STATE (Microetch2_R)	BUSY	3056	1.4820	5.43	5.43
	IDLE	3048	25.546	93.32	93.32
	FAILED	9	116.00	1.25	1.25
STATE (Acid Dip2_R)	BUSY	3068	1.6369	6.02	6.02
	IDLE	3065	25.432	93.42	93.42
	FAILED	4	116.00	0.56	0.56
STATE (Electroless Nickel)	BUSY	2448	23.069	67.69	67.69
	IDLE	2409	9.2664	26.75	26.75
	FAILED	40	116.00	5.56	5.56
STATE (Cleaner2_R)	BUSY	3063	3.4903	12.81	12.81
	IDLE	3056	23.538	86.21	86.21
	FAILED	7	116.00	0.97	0.97
STATE (Catalyst2_R)	BUSY	3067	3.7470	13.77	13.77
	IDLE	3062	23.268	85.39	85.39
	FAILED	6	116.00	0.83	0.83
STATE (Immersion Gold2_	BUSY	2966	18.521	65.84	65.84
	IDLE	2961	9.3911	33.33	33.33
	FAILED	6	116.00	0.83	0.83

NAME: Nickel/Palladium/Gold, non-conveyorized
Throughput: 60,000K ssf

ARENA Simulation Results

Replication ended at time: 19427.7 min.

Tally Variables

Identifier	Average	Half Width	Minimum	Maximum	Observations
Takt Time	27.150	(Corr)	17.830	134.33	710
Time in system	95.321	4.1505	86.100	193.43	711

Counters

Identifier	Count	Limit
Parts Done	711	Infinite

Frequencies

Identifier	Category	Number	AvgTime	Percent	Percent
STATE (Electroless Nicke	BUSY	605	21.541	67.08	67.08
	IDLE	597	8.9632	27.54	27.54
	FAILED	9	116.00	5.37	5.37
STATE (Acid Dip2_R)	BUSY	711	1.6300	5.97	5.97
	IDLE	712	25.495	93.44	93.44
	FAILED	1	116.00	0.60	0.60
STATE (Microetch2_R)	BUSY	705	1.4825	5.38	5.38
	IDLE	704	25.617	92.83	92.83
	FAILED	3	116.00	1.79	1.79
STATE (Cleaner2_R)	BUSY	708	3.4847	12.70	12.70
	IDLE	706	23.694	86.11	86.11
	FAILED	2	116.00	1.19	1.19
STATE (Catalyst2_R)	BUSY	711	3.7300	13.65	13.65
	IDLE	710	23.300	85.16	85.16
	FAILED	2	116.00	1.19	1.19
STATE (Immersion Gold2_	BUSY	684	18.533	65.25	65.25
	IDLE	683	9.5440	33.55	33.55
	FAILED	2	116.00	1.19	1.19

NAME: OSP, non-conveyorized
Throughput: 260,000K ssf

ARENA Simulation Results

Replication ended at time: 14371.9 min.

Tally Variables

Identifier	Average	Half Width	Minimum	Maximum	Observations
Takt Time	4.7599	.59985	4.6200	150.67	3080
Time in System	399.53	(Corr)	21.330	513.90	3081

Counters

Identifier	Count	Limit
Depart 7_C	3081	Infinite

Frequencies

Identifier	Category	Number	AvgTime	Percent	Percent
STATE (Cleaner_R)	BUSY	2301	4.6462	72.82	72.82
	IDLE	2294	1.2850	20.08	20.08
	FAILED	7	149.00	7.10	7.10
STATE (Osp_R)	BUSY	3081	1.6700	35.04	35.04
	IDLE	3081	3.0469	63.94	63.94
	FAILED	1	149.00	1.01	1.01
STATE (Microetch_R)	BUSY	2711	1.6706	30.85	30.85
	IDLE	2703	3.2600	60.02	60.02
	FAILED	9	149.00	9.13	9.13

NAME: OSP, non-conveyorized
Throughput: 60,000K ssf

ARENA Simulation Results

Replication ended at time: 3731.92 min.

Tally Variables

Identifier	Average	Half Width	Minimum	Maximum	Observations
Takt Time	5.0236	.57885	4.6200	150.47	710
Time in System	172.58	(Corr)	21.330	322.15	711

Counters

Identifier	Count	Limit
Depart 7_C	711	Infinite

Frequencies

Identifier	Category	Number	AvgTime	Percent	Percent
STATE (Cleaner_R)	BUSY	581	4.2464	66.11	66.11
	IDLE	579	1.6696	25.90	25.90
	FAILED	2	149.00	7.99	7.99
STATE (Osp_R)	BUSY	711	1.6700	31.82	31.82
	IDLE	711	3.3692	64.19	64.19
	FAILED	1	149.00	3.99	3.99
STATE (Microetch_R)	BUSY	619	1.6884	28.01	28.01
	IDLE	618	3.6241	60.02	60.02
	FAILED	3	149.00	11.98	11.98

NAME: OSP, conveyorized
Throughput: 260,000K ssf

ARENA Simulation Results

Replication ended at time: 6568.83 min.

Tally Variables

Identifier	Average	Half Width	Minimum	Maximum	Observations
Takt time	.14724	.01562	.13961	149.00	45936
Time in system	30.442	14.465	5.1777	154.12	45937

Counters

Identifier	Count	Limit
Depart 22_C	45937	Infinite

Frequencies

Identifier	Category	Number	AvgTime	Percent	Percent
STATE (Microetch2_R)	BUSY	45937	.00500	3.39	3.39
	IDLE	45932	.12290	83.40	83.40
	FAILED	6	149.00	13.21	13.21
STATE (Cleaner2_R)	BUSY	40587	.00566	3.39	3.39
	IDLE	40582	.13910	83.40	83.40
	FAILED	6	149.00	13.21	13.21
STATE (osp_R)	BUSY	45937	.00500	3.39	3.39
	IDLE	45937	.13911	94.41	94.41
	FAILED	1	149.00	2.20	2.20

NAME: OSP, conveyorized
Throughput: 60,000K ssf

ARENA Simulation Results

Replication ended at time: 2002.0 min.

Tally Variables

Identifier	Average	Half Width	Minimum	Maximum	Observations
Takt Time	.15805	.03019	.1356	149.00	1060
Time in System	27.077	(Corr)	5.1777	154.07	10600

Counters

Identifier	Count	Limit
Depart 22_C	10601	Infinite

Frequencies

Identifier	Category	Number	AvgTime	Percent	Percent
STATE (Microetch2_R)	BUSY	10601	.00500	2.65	2.65
	IDLE	10601	.16979	89.91	89.91
	FAILED	1	149.00	7.44	7.44
STATE (Cleaner2_R)	BUSY	9531	.00556	2.65	2.65
	IDLE	9530	.17324	82.47	82.47
	FAILED	2	149.00	14.89	14.89
STATE (OSP_R)	BUSY	10601	.00500	2.65	2.65
	IDLE	10601	.16979	89.91	89.91
	FAILED	1	149.00	7.44	7.44

NAME: Immersion Silver, conveyorized
Throughput: 60,000K ssf

ARENA Simulation Results

Replication ended at time: 5425.08 min.

Tally Variables

Identifier	Average	Half Width	Minimum	Maximum	Observations
Time in System	14.998	5.9815	11.189	125.07	10601
Takt time	.51074	(Corr)	.48953	113.99	10600

Counters

Identifier	Count	Limit
depart 44_C	10601	Infinite

Frequencies

Identifier	Category	Number	AvgTime	Percent	Percent
STATE (Microetch3_R)	BUSY	10601	.00500	0.98	0.98
	IDLE	10601	.49600	96.92	96.92
	FAILED	1	114.00	2.10	2.10
STATE (Cleaner3_R)	BUSY	10372	.00511	0.98	0.98
	IDLE	10370	.49605	94.82	94.82
	FAILED	2	114.00	4.20	4.20
STATE (Immersion Silver)	BUSY	10601	.00500	0.98	0.98
	IDLE	10601	.49600	96.92	96.92
	FAILED	1	114.00	2.10	2.10
STATE (prodip_R)	BUSY	10601	.00500	0.98	0.98
	IDLE	10600	.48529	94.82	94.82
	FAILED	2	114.00	4.20	4.20

NAME: Immersion Silver, conveyorized
Throughput: 260,000K ssf

ARENA Simulation Results

Replication ended at time: 26206.7 min.

Tally Variables

Identifier	Average	Half Width	Minimum	Maximum	Observations
Time in System	18.921	4.1632	11.189	238.69	45937
Takt Time	.50495	(Corr)	.48995	114.03	45936

Counters

Identifier	Count	Limit
depart 44_C	45937	Infinite

Frequencies

Identifier	Category	Number	AvgTime	Percent	Percent
STATE (Microetch3_R)	BUSY	45937	.00500	0.99	0.99
	IDLE	45932	.48535	96.06	96.06
	FAILED	6	114.00	2.95	2.95
STATE (Cleaner3_R)	BUSY	44792	.00513	0.99	0.99
	IDLE	44786	.49777	96.06	96.06
	FAILED	6	114.00	2.95	2.95
STATE (Immersion Silver)	BUSY	45937	.00500	0.99	0.99
	IDLE	45937	.49770	98.52	98.52
	FAILED	1	114.00	0.49	0.49
STATE (prodip_R)	BUSY	45021	.00510	0.99	0.99
	IDLE	45017	.49775	96.55	96.55
	FAILED	5	114.00	2.46	2.46

NAME: Immersion Tin, non-conveyorized
Throughput: 260,000K ssf

ARENA Simulation Results

Replication ended at time: 30669.2 min.

Tally Variables

Identifier	Average	Half Width	Minimum	Maximum	Observations
Takt Time	9.8516	(Corr)	8.5500	93.550	3080
Time in System	40.215	4.5278	26.010	185.18	3081

Counters

Identifier	Count	Limit
Depart 7_C	3081	Infinite

Frequencies

Identifier	Category	Number	AvgTime	Percent	Percent
STATE (Cleaner_R)	BUSY	3009	3.5530	35.20	35.20
	IDLE	3002	6.3568	62.84	62.84
	FAILED	7	85.000	1.96	1.96
STATE (predip_R)	BUSY	3049	1.1822	11.87	11.87
	IDLE	3045	8.6500	86.73	86.73
	FAILED	5	85.000	1.40	1.40
STATE (Immersion Tin_R)	BUSY	2003	13.151	86.74	86.74
	IDLE	2003	1.9678	12.98	12.98
	FAILED	1	85.000	0.28	0.28
STATE (Microetch_R)	BUSY	3008	1.5056	14.91	14.91
	IDLE	3000	8.3583	82.57	82.57
	FAILED	9	85.000	2.52	2.52

NAME: Immersion Tin, non-conveyorized
Throughput: 60,000K ssf

ARENA Simulation Results

Replication ended at time: 7144.18 min.

Tally Variables

Identifier	Average	Half Width	Minimum	Maximum	Observations
Takt Time	9.9108	.36935	8.5500	88.470	710
Time in System	36.380	7.8297	26.010	104.68	711

Counters

Identifier	Count	Limit
Depart 7_C	711	Infinite

Frequencies

Identifier	Category	Number	AvgTime	Percent	Percent
STATE (Cleaner_R)	BUSY	699	3.5295	34.53	34.53
	IDLE	697	6.4663	63.09	63.09
	FAILED	2	85.000	2.38	2.38
STATE (Predip_R)	BUSY	711	1.1700	11.64	11.64
	IDLE	712	8.7462	87.17	87.17
	FAILED	1	85.000	1.19	1.19
STATE (Immersion Tin_R)	BUSY	527	11.535	85.09	85.09
	IDLE	527	1.8598	13.72	13.72
	FAILED	1	85.000	1.19	1.19
STATE (Microetch_R)	BUSY	693	1.5081	14.63	14.63
	IDLE	692	8.4451	81.80	81.80
	FAILED	3	85.000	3.57	3.57

NAME: Immersion Tin, conveyorized
Throughput: 260,000K ssf

ARENA Simulation Results

Replication ended at time: 43501.6 min.

Tally Variables

Identifier	Average	Half Width	Minimum	Maximum	Observations
Takt Time	.95367	(Corr)	.93728	85.005	45936
Time in System	21.375	(Corr)	12.350	160.23	45937

Counters

Identifier	Count	Limit
Depart 22_C	45937	Infinite

Frequencies

Identifier	Category	Number	AvgTime	Percent	Percent
STATE (Microetch2_R)	BUSY	45936	.00500	0.54	0.54
	IDLE	45931	.91794	98.28	98.28
	FAILED	6	85.000	1.19	1.19
STATE (Cleaner2_R)	BUSY	45487	.00505	0.54	0.54
	IDLE	45481	.92702	98.28	98.28
	FAILED	6	85.000	1.19	1.19
STATE (Predip_R)	BUSY	45576	.00504	0.54	0.54
	IDLE	45572	.92704	98.47	98.47
	FAILED	5	85.000	0.99	0.99
STATE (Immersion Tin_R)	BUSY	45937	.00500	0.54	0.54
	IDLE	45937	.92707	99.27	99.27
	FAILED	1	85.000	0.20	0.20

NAME: Immersion Tin, conveyorized (Tin h 60)
Throughput: 60,000K ssf

ARENA Simulation Results

Replication ended at time: 10029.78 min.

Tally Variables

Identifier	Average	Half Width	Minimum	Maximum	Observations
Takt Time	.95796	(Corr)	.93728	85.260	10600
Time in Systemm	23.910	(Corr)	12.364	110.71	10601

Counters

Identifier	Count	Limit
Depart 22_C	10601	Infinite

Frequencies

Identifier	Category	Number	AvgTime	Percent	Percent
STATE (Microetch2_R)	BUSY	10601	.26000	27.69	27.69
	IDLE	10601	.67102	71.46	71.46
	FAILED	1	85.000	0.85	0.85
STATE (Cleaner2_R)	BUSY	10476	.26310	27.69	27.69
	IDLE	10475	.67098	70.60	70.60
	FAILED	2	85.000	1.71	1.71
STATE (Predip_R)	BUSY	10601	.26000	27.69	27.69
	IDLE	10600	.66307	70.60	70.60
	FAILED	2	85.000	1.71	1.71
STATE (Immersion Tin_R)	BUSY	10601	.26000	27.69	27.69
	IDLE	10601	.67102	71.46	71.46
	FAILED	1	85.000	0.85	0.85

G-5 Chemical Costs by Bath for Individual Surface Finish Processes

Process: Hot Air Solder Leveling (HASL)[a]

Bath	Volume in Bath (in gallons) Horizontal	Volume in Bath (in gallons) Vertical	Supplier ID	Unit Vol. Chemical Cost	Avg. Chemical Cost	Total Cost of the Bath (Horizontal)	Total Cost of the Bath (Vertical)
Cleaner	66.5	51.1	#1	$14.4/gal	$3.67/gal	$244	$188
			#2	$5.42/gal			
			#3	$1.38/gal			
			#4	$1.13/gal			
			#5	$2.50/gal			
			#6	$1.00/gal			
			#7	$1.02/gal			
			#8	$2.50/gal			
Microetch	86.6	51.1	#1	$1.43/gal	$3.86/gal	$344	$197
			#2	$2.14/gal			
			#3	$0.757/gal			
			#4	$9.88/gal			
			#5	$5.20/gal			
			#6	$5.20/gal			
			#7	$1.05/gal			
			#8	$5.20/gal			
Flux	NA	NA		$12.50/gal		$12.50/gal[b]	$12.50/gal [b]

[a] No suppliers of HASL were identified. Chemical costs for baths similar to other alternatives were calculated by averaging the individual bath costs from other alternatives.

[b] Flux is refilled as it is consumed. The flux cost per gallon was obtained by industry estimate. (Personal communication with Mark Carey, February, 2000.)

Process: Immersion Silver
Supplier #1

Bath	Volume in Bath (in gallons) Horizontal	Volume in Bath (in gallons) Vertical	Chemical Name	Percentage of Chemical in Bath	Cost of Chemicals	Multiplying Factor	Total Cost of the Bath (Horizontal)	Total Cost of the Bath (Vertical)
Cleaner	66.5	No data	A	100	$14.4/gal	1	$958	No data
Microetch	86.6	No data	B	5	$26.6/gal	1	$124	No data
			C	0.25	$1.20/gal	1		
			D	10	$1.00/gal	1		
Predip	46.2	No data	E	100	$26.0/gal	1	$1,200	No data
Immersion Silver	NA	No data	F	90	$26.0/gal	1	$30.9/gal[a]	No data
			G	10	$75.0/gal	1		

[a] The silver bath is not replaced, but rather maintained as it becomes depleted. The total material cost of the silver bath required to produce 260,000 ssf of PWB will be calculated directly from the price per gallon of bath solution and the total gallons of bath solution required.

Process: Immersion Tin
Supplier #2

Bath	Volume in Bath (in gallons) Horizontal	Volume in Bath (in gallons) Vertical	Chemical Name	Percentage of Chemical in Bath	Cost of Chemicals	Multiplying Factor	Total Cost of the Bath (Horizontal)	Total Cost of the Bath (Vertical)
Cleaner	66.5	51.1	A	7	$20.0/L	1	$360	$277
			B	10	$1.20/gal	1		
Microetch	86.6	51.1	C	1.25 lb/gal	$1.70/lb	1	$185	$109
			D	1	$1.20/gal	1		
Predip	46.2	51.1	E	0.5	$40.0/L	1	$34.9	$38.7
Immersion Tin	NA	NA	F	5	$1.20/gal	1	$166/gal[a]	$166/gal[a]
			G	200 g/L	$40.0/kg	2.24		
			H	10	$40.0/L	3.48		
			I	5	$40.0/L	5.94		

[a] The tin bath is not replaced, but rather maintained as it becomes depleted. The total material cost of the tin bath required to produce 260,000 ssf of PWB will be calculated directly from the price per gallon of bath solution and the total gallons of bath solution required.

Process: Immersion Tin
Supplier #3

Bath	Volume in Bath (in gallons) Horizontal	Volume in Bath (in gallons) Vertical	Chemical Name	Percentage of Chemical in Bath	Cost of Chemicals	Multiplying Factor	Total Cost of the Bath (Horizontal)	Total Cost of the Bath (Vertical)
Cleaner	66.5	51.1	A	12.5	$11.0/gal	1	$91.4	$70.3
Microetch	86.6	51.1	B	60 g/L	$1.49/lb	1	$65.6	$38.7
			C	1	$1.20/gal	1		
Predip	46.2	51.1	D	25	$100/gal	1	$1,160	$1,280
Immersion Tin	NA	NA	E	100	$100/gal	1	$100/gal[a]	$100/gal[a]

[a] The tin bath is not replaced, but rather maintained as it becomes depleted. The total material cost of the tin bath required to produce 260,000 ssf of PWB will be calculated directly from the price per gallon of bath solution and the total gallons of bath solution required.

Process: Electroless Nickel/Immersion Gold
Supplier #4

Bath	Volume in Bath (in gallons) Horizontal	Volume in Bath (in gallons) Vertical	Chemical Name	Percentage of Chemical in Bath	Cost of Chemicals	Multiplying Factor	Total Cost of the Bath (Horizontal)	Total Cost of the Bath (Vertical)
Cleaner	No data	51.1	A	15	$7.50/gal	1	No data	$57.5
Microetch	No data	51.1	B	1.88 lb/gal	$5.25/lb	1	No data	$505
			C	1	$1.20/gal	1		
Catalyst	No data	51.1	D	10	$40.0/gal	1	No data	$467
			E	17	$8.00/L	1		
Acid Dip	No data	51.1	F	40	$8.00/L	1	No data	$619
Electroless Nickel	No data	51.1	G	5	$14.5/gal	5	No data	$574
			H	15	$20.0/gal	1		
			J	5	$23.0/gal	4		
Immersion Gold	No data	51.1	K	0.250 unit/gal (225 mL/gal)	$344/unit	1	No data	$58,500[a]
			L	8 oz/gal	$3.25/lb	1		

[a] Immersion gold replacement cost was calculated differently than other baths because of the wide disparity in costs and throughput between product lines. The overall cost for the gold bath was calculated for each product line and then averaged together to give the gold cost for the process.

Process: Electroless Nickel/Immersion Gold
Supplier #5

Bath	Volume in Bath (in gallons) Horizontal	Volume in Bath (in gallons) Vertical	Chemical Name	Percentage of Chemical in Bath	Cost of Chemicals	Multiplying Factor	Total Cost of the Bath (Horizontal)	Total Cost of the Bath (Vertical)
Cleaner	No data	51.1	A	10	$25.0/gal	1	No data	$128
Microetch	No data	51.1	B	3	$5.66/gal	1	No data	$266
			C	3	$9.39/gal	1		
			D	45 g/L	$27.3/kg	1		
			E	8.5	$1.20/gal	1		
Catalyst	No data	51.1	F	30	$127/gal	1	No data	$2,810
			G	20	$54.0/gal	1		
			H	12	$51.0/gal	1		
Acid Dip	No data	51.1	I	2 g/L	$29.1/kg	1	No data	$11.3
Electroless Nickel	No data	51.1	J	6.6	$24.1/gal	6	No data	$2,390
			K	15	$30.9/gal	6		
			L	6.6	$28.4/gal	5		
Immersion Gold	No data	51.1	M	50	$21.4/gal	1	No data	$57,350[a]
			N	3 g/L	$40.0/g	3		

[a] Immersion gold replacement cost was calculated differently than other baths because of the wide disparity in costs and throughput between product lines. The overall cost for the gold bath was calculated for each product line and then averaged together to give the gold cost for the process.

Process: OSP
Supplier #6

Bath	Volume in Bath (in gallons) Horizontal	Volume in Bath (in gallons) Vertical	Chemical Name	Percentage of Chemical in Bath	Cost of Chemicals	Multiplying Factor	Total Cost of the Bath (Horizontal)	Total Cost of the Bath (Vertical)
Cleaner	66.5	51.1	A	10	$10.0/gal	1	$66.5	$51.1
Microetch	86.6	51.1	B	3	$5.66/gal	1	$451	$261
			C	3	$9.39/gal	1		
			D	45.0 g/L	$27.3/kg	1		
			E	8.5	$1.20/gal	1		
OSP	NA	NA	F	6	$324/gal	1	$93.6/gal[a]	$93.6/gal[a]
			G	23	$321/gal	1		

[a] The OSP bath is not replaced, but rather maintained as it becomes depleted. The total material cost of the OSP bath required to produce 260,000 ssf of PWB will
be calculated directly from the price per gallon of bath solution and the total gallons of bath solution required.

Process: OSP
Supplier #7

Bath	Volume in Bath (in gallons) Horizontal	Volume in Bath (in gallons) Vertical	Chemical Name	Percentage of Chemical in Bath	Cost of Chemicals	Multiplying Factor	Total Cost of the Bath (Horizontal)	Total Cost of the Bath (Vertical)
Cleaner	66.5	51.1	A	10	$10.2/gal	1	$67.8	$52.1
Microetch	86.6	51.1	B	2.5	$7.62/gal	1	$91.0	$53.7
			C	7	$9.12/gal	1		
			D	18.5	$1.20/gal	1		
OSP	NA	NA	E	100	$117/gal	1	$117/gal[a]	$117/gal[a]

[a] The OSP bath is not replaced, but rather maintained as it becomes depleted. The total material cost of the OSP bath required to produce 260,000 ssf of PWB will
be calculated directly from the price per gallon of bath solution and the total gallons of bath solution required.

Process: Electroless Nickel/Electroless Palladium/Immersion Gold
Supplier #8

Bath	Volume in Bath (in gallons) Horizontal	Volume in Bath (in gallons) Vertical	Chemical Name	Percentage of Chemical in Bath	Cost of Chemicals	Multiplying Factor	Total Cost of the Bath (Horizontal)	Total Cost of the Bath (Vertical)
Cleaner	No data	51.1	A	10	$25.0/gal	1	No data	$128
Microetch	No data	51.1	B	3	$5.66/gal	1	No data	$266
			C	3	$9.39/gal	1		
			D	45 g/L	$27.3/kg	1		
			E	8.5	$1.20/gal	1		
Catalyst	No data	51.1	F	30	$127/gal	1	No data	$2,810
			G	20	$54.0/gal	1		
			H	12	$51.0/gal	1		
Acid Dip	No data	51.1	I	2 g/L	$29.1/kg	1	No data	$11.3
Electroless Nickel	No data	51.1	J	6.6	$24.1/gal	6	No data	$2,390
			K	15	$30.9/gal	6		
			L	6.6	$28.4/gal	5		
Preinitiator	No data	51.1	M	20	$160/gal	1	No data	$2,430
			N	10	$152/gal	1		
			O	1.4	$8.00/L	1		
Electroless Palladium	No data	51.1	P	2.5	$943/gal	3	No data	$3,980
			Q	20	$23.8/gal	1		
			R	2.5	$48.2/gal	2		
			S	0.05	$13.3/gal	3		
Immersion Gold	No data	NA	T	50	$21.4/gal	1	No data	$57,900[a]
			U	3 g/L	$40.0/g	3		

[a] Immersion gold replacement cost was calculated differently than other baths because of the wide disparity in costs and throughput between product lines. The overall cost for the gold bath was calculated for each product line and then averaged together to give the gold cost for the process.

G-6 Total Materials Cost for Surface Finishing Processes

Process: HASL, non-conveyorized
Throughput: 260K ssf of PWB

Bath	Chemical Cost/Bath Replacement [a]	Number of Bath Replacements [b]	Total Chemical Cost
Cleaner	$188	7	$1,320
Microetch	$197	9	$1,770
Flux	$16,250 [c]	1	$16,250
Solder	$55,460 [d]	1	$55,460
Total Materials Cost			**$74,800**

[a] Reported chemical cost per bath replacement reflects the average bath cost of all processes submitted for evaluation in this surface finishing category.
[b] Number of bath replacements required to process 260,000 ssf as determined by process simulation.
[c] Flux bath is not replaced, but rather refilled as flux is consumed. Cost of flux was calculated at $12.50/gal and is consumed at 200 ssf/gal.
[d] Solder is not replaced, but rather refilled as solder is consumed. Cost of solder was calculated using a solder cost of $2.57/lb and an average solder consumption rate, including solder wastage, of 0.083 lb/ssf which was obtained from three PWB facilities.

Process: HASL, conveyorized
Throughput: 260K ssf of PWB

Bath	Chemical Cost/Bath Replacement [a]	Number of Bath Replacements [b]	Total Chemical Cost
Cleaner	$244	6	$1,460
Microetch	$344	6	$2,060
Flux	$16,250 [c]	1	$16,250
Solder	$55,460 [d]	1	$55,460
Total Materials Cost			**$75,200**

[a] Reported chemical cost per bath replacement reflects the average bath cost of all processes submitted for evaluation in this surface finishing category.
[b] Number of bath replacements required to process 260,000 ssf as determined by process simulation.
[c] Flux bath is not replaced, but rather refilled as flux is consumed. Cost of flux was calculated at $12.50/gal and is consumed at 200 ssf/gal.
[d] Solder is not replaced, but rather refilled as solder is consumed. Cost of solder was calculated using a solder cost of $2.57/lb and an average solder consumption rate, including solder wastage, of 0.083 lb/ssf which was obtained from three PWB facilities.

Process: Electroless Nickel/Immersion Gold, non-conveyorized
Throughput: 260K ssf of PWB

Bath	Chemical Cost/Bath Replacement [a]	Number of Bath Replacements [b]	Total Chemical Cost
Cleaner	$92.8	7	$649
Microetch	$386	9	$3,470
Catalyst	$1,640	6	$9,830
Acid Dip	$315	4	$1,260
Electroless Nickel	$890	40	$35,500
Immersion Gold	NA [c]	6	$57,900
Total Materials Cost			**$108,600**

[a] Reported chemical cost per bath replacement reflects the average bath cost of all processes submitted for evaluation in this surface finishing category.

[b] Number of bath replacements required to process 260,000 ssf as determined by process simulation.

[c] Immersion gold replacement cost was calculated differently than other baths because of the wide disparity in costs and throughput between product lines. The overall cost for the gold bath was calculated for each product line and then averaged together to give the gold cost for the process.

Process: Electroless Nickel/Electroless Palladium/Immersion Gold, non-conveyorized
Throughput: 260K ssf of PWB

Bath	Chemical Cost/Bath Replacement [a]	Number of Bath Replacements [b]	Total Chemical Cost
Cleaner	$128	7	$900
Microetch	$266	9	$2,390
Catalyst	$2,810	6	$16,860
Acid Dip	$11.3	4	$45
Electroless Nickel	$2,390	40	$95,600
Preinitiator	$2,430	5	$12,150
Electroless Palladium	$3,980	34	$135,300
Immersion Gold	NA [c]	6	$57,900
Total Materials Cost			**$321,000**

[a] Reported chemical cost per bath replacement reflects the average bath cost of all processes submitted for evaluation in this surface finishing category.

[b] Number of bath replacements required to process 260,000 ssf as determined by process simulation.

[c] Immersion gold replacement cost was calculated differently than other baths because of the wide disparity in costs and throughput between product lines. The overall cost for the gold bath was calculated for each product line and then averaged together to give the gold cost for the process.

Process: OSP, non-conveyorized
Throughput: 260K ssf of PWB

Bath	Chemical Cost/Bath Replacement [a]	Number of Bath Replacements [b]	Total Chemical Cost
Cleaner	$51.6	7	$361
Microetch	$157	9	$1,420
OSP	$16,750 [c]	1	$16,750
Total Materials Cost			**$18,500**

[a] Reported chemical cost per bath replacement reflects the average bath cost of all processes submitted for evaluation in this surface finishing category.

[b] Number of bath replacements required to process 260,000 ssf as determined by process simulation.

[c] OSP bath is not replaced, but rather refilled as the OSP is consumed. Cost of OSP was calculated at $105/gal and is consumed at 1,630 ssf/gal.

Process: OSP, conveyorized
Throughput: 260K ssf of PWB

Bath	Chemical Cost/Bath Replacement [a]	Number of Bath Replacements [b]	Total Chemical Cost
Cleaner	$67.2	6	$403
Microetch	$271	6	$1,630
OSP	$16,750 [c]	1	$16,800
Total Materials Cost			**$18,800**

[a] Reported chemical cost per bath replacement reflects the average bath cost of all processes submitted for evaluation in this surface finishing category.

[b] Number of bath replacements required to process 260,000 ssf as determined by process simulation.

[c] OSP bath is not replaced, but rather refilled as the OSP is consumed. Cost of OSP was calculated at $105/gal and is consumed at 1,630 ssf/gal.

Process: Immersion Silver, conveyorized
Throughput: 260K ssf of PWB

Bath	Chemical Cost/Bath Replacement [a]	Number of Bath Replacements [b]	Total Chemical Cost
Cleaner	$958	6	$5,750
Microetch	$124	6	$744
Predip	$1,200	5	$6,000
Immersion Silver	$40,170 [c]	1	$40,200
Total Materials Cost			**$52,700**

[a] Reported chemical cost per bath replacement reflects the average bath cost of all processes submitted for evaluation in this surface finishing category.
[b] Number of bath replacements required to process 260,000 ssf as determined by process simulation.
[c] Silver bath is not replaced, but rather maintained as the silver bath is depleted. The cost of the silver bath was calculated at $30.9/gal and is consumed at 200 ssf/gal.

Process: Immersion Tin, non-conveyorized
Throughput: 260K ssf of PWB

Bath	Chemical Cost/Bath Replacement [a]	Number of Bath Replacements [b]	Total Chemical Cost
Cleaner	$174	7	$1,220
Microetch	$74	9	$665
Predip	$659	5	$3,300
Immersion Tin	$23,850 [c]	1	$23,850
Total Materials Cost			**$29,000**

[a] Reported chemical cost per bath replacement reflects the average bath cost of all processes submitted for evaluation in this surface finishing category.
[b] Number of bath replacements required to process 260,000 ssf as determined by process simulation.
[c] Tin bath is not replaced, but rather maintained as the tin bath is depleted. The cost of the tin bath was calculated at $133/gal and is consumed at 1,450 ssf/gal.

Process: Immersion Tin, conveyorized
Throughput: 260K ssf of PWB

Bath	Chemical Cost/Bath Replacement [a]	Number of Bath Replacements [b]	Total Chemical Cost
Cleaner	$226	6	$1,350
Microetch	$125	6	$752
Predip	$597	5	$2.990
Immersion Tin	$23,850 [c]	1	$23,850
Total Materials Cost			**$28,900**

[a] Reported chemical cost per bath replacement reflects the average bath cost of all processes submitted for evaluation in this surface finishing category.
[b] Number of bath replacements required to process 260,000 ssf as determined by process simulation.
[c] Tin bath is not replaced, but rather maintained as the tin bath is depleted. The cost of the tin bath was calculated at $133/gal and is consumed at 1,450 ssf/gal.